BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images may include (but are not limited to):

- BLACK BORDERS
- TEXT CUT OFF AT TOP, BOTTOM OR SIDES
- FADED TEXT
- ILLEGIBLE TEXT
- SKEWED/SLANTED IMAGES
- COLORED PHOTOS
- BLACK OR VERY BLACK AND WHITE DARK PHOTOS
- GRAY SCALE DOCUMENTS

IMAGES ARE BEST AVAILABLE COPY.

As rescanning documents *will not* correct images, please do not report the images to the Image Problem Mailbox.

(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 789 322 B1

(12) EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention of the grant of the patent:
27.11.2002 Bulletin 2002/48

(51) Int Cl.[7]: **G06K 15/00**, G03G 15/00

(21) Application number: **97300003.7**

(22) Date of filing: **02.01.1997**

(54) Replaceable part with integral memory for usage, calibration and other data

Ersatzteil mit integriertem Speicher für Gebrauchs-, Eichungs- und andere Daten

Pièce de rechange à mémoire intégrée pour des données d'usage, de calibration et autres

(84) Designated Contracting States:
DE FR GB IT

(30) Priority: **08.01.1996 US 584499**

(43) Date of publication of application:
13.08.1997 Bulletin 1997/33

(73) Proprietor: **Hewlett-Packard Company,**
A Delaware Corporation
Palo Alto, CA 94304 (US)

(72) Inventors:
- **Bullock, Michael L.**
  San Diego, CA 92128 (US)
- **Childers, Winthrop D.**
  San Diego, CA 92127 (US)
- **Hirst, Mark B.**
  Boise, ID 83704 (US)
- **Stephens, Ronald D. Jr.**
  Escondido, CA 92029 (US)
- **Gil Miquel, Antoni**
  08201 Sabadell (ES)

(74) Representative: **Carpmaels & Ransford**
43 Bloomsbury Square
London WC1A 2RA (GB)

(56) References cited:
EP-A- 0 195 655
EP-A- 0 721 171
WO-A-90/00974
WO-A-90/14626
US-A- 5 049 898
US-A- 5 132 729
US-A- 5 270 972
US-A- 5 365 312
US-A- 5 452 059

EP 0 789 322 B1

Printed by Jouve, 75001 PARIS (FR)

Description

Related Patent Application

[0001] Reference is made to U.S. Patent 5 491 540 by the same applicant.

Field of the Invention

[0002] This invention relates to apparatus that employs replaceable, consumable, parts and supplies and, more particularly, to replaceable, consumable parts and supplies that include integral memory for storing usage, calibration and other data.

Background of the Invention

[0003] Substantially all present-day copiers, printers, plotters, etc. include a controlling microprocessor which requires input calibration data for internal components so as to enable high quality production of documents. Since most such apparatus is produced so as to allow user-replacement of consumable items, entry of usage and calibration data must be performed by the user (or repair-person) who is performing the replacement operation. Any error in entry of calibration data can substantially degrade the apparatus or render the apparatus inoperative.

[0004] To determine usage of consumables, the prior art has generally been restricted to simple record-keeping entries which enable the user to know when replacement is required. For instance, copiers often display a count of the number of output pages and maintain an internal record of the number of rotations of the drum (or of an organic photoconductor web) to enable the processor to signal when service or replacement is required.

[0005] Replaceable developer modules are currently employed in many electrophotographic printers and copiers. Each developer module includes a supply of toner and toner carrier along with a mechanism to bring the toner/carrier mixture to a drum (or web) surface. To provide proper control signal levels for a laser exposure system, the control microprocessor adjusts the ratio of toner to carrier so as to achieve a proper mixture. One method for controlling the toner-to-carrier ratio is to provide an oscillator circuit whose frequency is varied by the toner-to-carrier ratio. Upon an initial installation of a new developer module, the control processor takes a number of minutes to accumulate sufficient data from the oscillator circuit to determine the toner-to-carrier ratio so as to enable a setting of the proper signal levels in the laser exposure system. If the developer module is removed from the apparatus or is transferred to another apparatus, the entire calibration procedure must be repeated.

[0006] While, as above indicated, printers and copiers have heretofore retained an output page count, such a raw page count does not take into account different wear levels created by different media types. For instance, a fuser assembly (which includes a pair of platen rollers, one or both being heated) manifests a surface breakdown phenomenon after approximately 80,000 pages of a standard media type. Different media types cause a variation in fuser assembly wear and a simple page count does account for such variations.

[0007] Fuser assemblies used with color printers employ a silicone oil to increase color saturation level and to provide a glossy finish to printed media sheets. Different media types require variations in the amount of applied oil. A control system is provided to enable the fuser assembly to know the particular type of media sheet so as to enable a determination of the amount of oil to be deposited. While the processor maintains track of cumulative oil usage, if the fuser assembly is removed or the stored data regarding oil usage is lost, there is no way to reconstruct the usage state of the fuser assembly when it is put back into service.

[0008] In a similar fashion, an electrophotographic drum includes a photosensitive layer that manifests a determined charge sensitivity. Such charge sensitivity data is employed as a control parameter in the power control loop of the laser exposure system. Heretofore, such charge sensitivity data has been entered by the operator. If, however, the drum is transferred between printers, as may happen during servicing, such data does not travel with the drum but must be reentered.

[0009] Ink jet printers employ disposable printheads with integral ink supplies. U.S. Patent 5,049,898 to Arthur et al., assigned to the same Assignee as this application, discloses a disposable printing assembly wherein an integral memory element stores data that characterizes the assembly. Arthur et al. provide an ink jet printhead assembly with a memory which designates the color of ink in the print head, its amount, and the position of the ink jet orifice plate on the print head body. This data is read from the print head by a read/write element in the printer and is then used or displayed, as desired.

[0010] Ink jet printers employ a number of parameters (from an installed printer driver) to enable reliable operation of the printhead and continued production of high quality print jobs. As is known, thermal ink jet printheads employ a heater resistor at each ink jet orifice which, upon energization, causes the ejection of one or more ink drops. The amount of current applied to a heater resistor to achieve a desired ink drop volume is determined by a combination of factors and is the product of a calculated algorithm. Drop volume is dependent upon sensed temperature, constants that reflect the ink's characteristics, the structural arrangement of the ink orifice, etc. Those parameters are provided by the printer driver to the ink jet printer, upon power-up.

[0011] If it is determined by the manufacturer, that such parameters require modification, the manufacturer must issue a printer driver update and arrange to supply

that update to both previous and current customers. Further, if the design of a printhead is changed during manufacture, such change will often require alterations to the parameters. Here again, a new printer driver is required.

[0012] Many consumable, replacement parts for printers/copiers include a fuse that is integral to the replacement part and identifies whether the replacement part is new or used. If, upon insertion of the replacement part, the controlling microprocessor determines that the fuse is intact, the machine determines that the replacement part is new and zeros out its count values which indicate the remaining usable life for the part. When further input data concerning the replacement part is required, the microprocessor either indicates the need for such data to the user via a control panel or automatically gathers the data from a replacement part sensor (as in the case of the toner-to-carrier ratio in a developer module). Thereafter, the fuse is blown.

[0013] Such a prior art circuit is shown in Fig. 1 for an electrophotographic printer wherein each of a plurality of consumable parts are plug connected to a printer at an interface 10. The plug-connected consumable items include an oil pad module 12, a black (K) toner developer module 14, a color developer module 16, a fuser assembly 18, a transfer assembly 20, and a photographic drum assembly 22. Those skilled in the art will realize that there are other additional consumable items which can also be plug connected to a printer, in addition to the aforementioned consumable parts. Each consumable item includes a fuse 24 that is blown by fuse blow circuitry module 26 upon completion of a calibration action by control computer 28. Fuse 24 is incorporated into the structure of each of the replacement items and is connected via a single wire to a contact 30 in a multiple contact connector, which interfaces with a connector in the printer. A ground connection 32 within the replacement item enables a complete circuit to be made through fuse 24.

[0014] EP-A-0 721 171, which forms part of the state of the art by virtue of Article 54(3) EPC in respect of the designated states France, Germany and the United Kingdom only, describes a printer/copier apparatus adapted to receive replacement parts which are subject to wear or which comprise a consumable employed during the printing operation. The replaceable part comprises a serial access memory connected by only a single wire to the printer/copier apparatus enabling data transfer between the memory and the processor.

[0015] WO-A-9000974 describes a printing system wherein ink reservoirs are provided with non-volatile memory elements which store data indicative of the quantity of ink remaining and the identity of the reservoir.

[0016] US-A-5 452 059 describes a printer wherein a consumable unit is provided with a non-volatile memory element which stores data indicative of the cumulative use of the consumable unit, wherein data are written into and out of the memory element serially on respective input and output lines.

[0017] US-A-5 270 972 describes a memory device wherein data are communicated to and from the memory using a single data terminal.

[0018] It would be desirable to provide a replaceable part/consumable with an integral memory that enables both usage and calibration data to be stored and altered.

[0019] It would further be desirable to provide a replaceable part/consumable with a memory module that requires no modification to a pre-existing physical interface between the part/consumable and apparatus in which the part/consumable is placed.

SUMMARY OF THE INVENTION

[0020] The present invention is defined by claim 1.

[0021] In a preferred embodiment of the present invention, an ink jet printer/copier apparatus is adapted to receive a replacement ink cartridge that is employed during the printing/copying operation. The apparatus includes a receptacle with a first connector that is coupled to a processor which controls operation of the apparatus. The cartridge includes a second connector which mates with the first connector and a memory that is connected to the second connector. Data transfers are enabled both from and to the memory to enable access and modification of data stored therein that is indicative of cartridge usage, calibration, and to parameters for controlling operation of the apparatus. Usage of a serial access memory on the cartridge, which enables input/output over a single wire, enables a direct substitution of the memory in place of a presently provided fuse, without requiring changes to the physical interface between the cartridge and the connectors which enable mating of the cartridge with the apparatus.

DESCRIPTION OF THE DRAWINGS

[0022] Fig. 1 is a block diagram of a prior art apparatus wherein each replaceable part includes an integral fuse that is wired to an interface connector via a single wire.

[0023] Fig. 2 is a block diagram that illustrates the invention.

[0024] Fig. 3 illustrates further detail of an interface portion of a replaceable part, showing a one wire interconnection for an on-board serial access memory.

[0025] Fig. 4 is a perspective view of a replaceable ink cartridge for an ink jet printer.

[0026] Fig. 5 is a schematic diagram illustrating apparatus for interconnecting the ink cartridge of Fig. 4 to an ink jet printhead and, further, for making connection to a memory chip resident on the ink cartridge.

[0027] Fig. 6 is a logic flow diagram illustrating the operation of the printer system of Fig. 5 in accordance with data stored on an ink cartridge.

[0028] Fig. 7 is a logic flow diagram illustrating the operation of the printer system of Fig. 5 in accordance with ink usage data stored on an ink cartridge.

DETAILED DESCRIPTION OF THE INVENTION

[0029] Hereafter, the invention will be described in the context of an electrophotographic printer and an ink jet printer, however, it is to be understood that the invention is applicable to any computer-controlled apparatus that includes replaceable parts/consumables.

[0030] As will be understood, the invention enables usage and calibration data to be stored in a single wire memory module that is incorporated into a replaceable part. Thus, if the replaceable part is transferred from first apparatus to second apparatus, the second apparatus is enabled to adjust its control parameters in accordance with the data stored in the part's on-board memory. This is critical when data from the replaceable part must be interrelated with other data to enable derivation of apparatus control signals. For instance, humidity data that is internally sensed within a printer, when combined with a photoconductor's sensitivity data, directly influences the laser's exposure settings. If incorrect photoconductor sensitivity data is utilized, printer performance is adversely affected.

[0031] Recently, single wire input/output, serial memories have become available in the marketplace, e.g. as described in WO-A-90/14626. One such memory family comprises the DS1992-DS1995 Touch Memories from Dallas Semi-Conductors Inc. Each of those memories is configured as a nonvolatile, random-access memory with storage sizes which range from 1K - 16K bytes. In the case of the DS1992, the internal 128 bytes of nonvolatile RAM are organized as four storage areas of 32 bytes each and a scratch pad of 32 bytes. Data input and output from the one wire memory is accomplished via a protocol wherein various length pulses are employed which evidence the beginning of a read/write action. Those pulses are followed by bit-by-bit transfers, wherein ones and zeros are manifest by different pulse lengths. Other serial input/output memories are also usable with this invention.

Electrophotographic Printer

[0032] Referring to Fig. 2, each replaceable part/consumable mates with a receptacle 36 (shown schematically) within a printer 38. Each of the fuses shown in Fig. 1 have been replaced by a memory chip 40 which connects to the preexisting connector 30 via a wire 42 and enables storage of both usage and calibration data regarding the replaceable part. In Fig. 3, a further detailed view is shown of an interface between a replaceable part 50 and a connector 52 within a printer. Replaceable part 50 includes a plurality of sensors A-N that are interconnected with an interface board 54 on which one-wire memory chip 40 and electronics module 56 are mounted. (Most of the interconnections on board 54 are not shown to avoid an over-complication of the view.) Sensors A-N feed signals to electronics module 56 which provides an interface function to connector 52 and the various control and sense lines that are connected thereto. Line 42 from one-wire memory chip 40 is connected via contact 30 to memory line 58 which is, in turn, connected to control computer 28 so as to enable both reading and writing actions with respect to memory chip 40.

[0033] In order to enable control computer 28 to identify the particular replaceable part, it is preferred that blocks of serial numbers be preassigned to replaceable part types. Control computer 28 is pre-loaded with appropriate data that enables identification of the particular replaceable part, simply by reading the serial number stored in memory chip 40 carried by the replaceable part.

[0034] During operation of the printer, control computer 28 is periodically activated to cause outputs from sensors A-N to be recorded so as to enable use of the sensed data in rendering system adjustments. In this regard, data from plural memory chips are correlated so as to enable more accurate adjustments than heretofore. For example, as indicated above, fuser assemblies have determined the amount of silicone oil to apply to a media sheet in dependence upon the type of media sheet being fed. Prior art systems have employed a light sensor to detect the reflectivity of the media sheet in order to alter a silicone oil deposition rate. As the silicone oil is contained in a sponge-like media, the fuser assembly rollers are slowed to achieve a greater silicone oil deposition upon selected types of media sheets. Currently, EP printers slow the fuser rollers by approximately 50% when overhead transparencies are fused. This slow down roughly doubles the amount of silicone oil deposited. Through the use of this invention and detailed knowledge of past silicone oil usage - as derived from data stored in a memory chip 40, the temperature of the fuser rollers can be increased to increase the silicone oil release rate to obtain a desired color saturation level - without decreasing the roller speed. Thus, with precise knowledge of past silicone oil usage history, the temperature of fuser rollers can be altered by control computer 28 to allow the fuser system to operate at full speed while the silicone oil is being deposited at the higher temperature.

[0035] In a similar manner, data can be stored in a memory chip 40 which enables more accurate control in response to developer module parameters. Presently, the only information stored by control computer 28 regarding a color developer module is a sensor offset, a page count, and a humidity value. The sensor offset is used to control the toner-to-carrier ratio. Page count is used to also modify the toner-to-carrier ratio to compensate for aging of the developer's mechanical assemblies and aging of the carrier, per se. It will be recalled that the carrier is a magnetic material used to convey toner and helps develop proper electrostatic charges on the toner particles.

[0036] Memory chip 40 will preferably store additional data regarding developer module parameters that affect

image production. Those parameters will include: developer magnet strength; absolute distance between the developer sleeve and the photoconducting drum; developer surface roughness and absolute magnet angle. Each of the aforesaid parameters directly affects development quality and will enable control computer 28, upon determining the aforesaid stored parameters, to more accurately compensate for variations thereof. Similarly, a memory chip 40 associated with a drum would record a parameter defining the drums' photosensitivity (i.e. charge and discharge characteristics). Control computer 28 will compensate for variations in that parameter by adjusting toner carrier ratio, laser power and bias settings for both the developer module and the drum photoconductor.

[0037] Further, carrier particles employed with the toner exhibit a charge-to-mass ratio which is a measure of the carrier's ability to impart a charge to the toner. Such charge-to-mass ratio is recorded after manufacture and a low charge-to-mass ratio means that there is less control of the toner and that it is emplaced more easily on the drum. Such charge-to-mass ratio, as measured by the manufacturer, can be stored in a memory chip 40 attached to each developer module. Upon initialization, a printer would adjust a number of settings in the printer to compensate for a charge-to-mass ratio which falls outside of an expected range (e.g., the toner-to-carrier ratio could be altered, the drum bias setting changed, the laser power setting or the developer bias setting altered etc.).

[0038] Upon receiving updated sensor data and performing the necessary calculations, control computer 28 causes revised usage and/or calibration data to be written to the respective memory chips 40 to update their memory states. Thus, if a replaceable part from a first printer is transferred to a second printer, control computer 28 in the second printer is enabled to access the usage and calibration data of the newly substituted replaceable part and to accurately adjust its operating states in accordance therewith.

Ink Jet Printer

[0039] Referring now to Figs. 4 and 5, an ink jet print cartridge 60 includes an internal reservoir 62 for holding a supply of ink. A fluidic interconnect 64 enables a receptacle 66 to receive ink from cartridge 60. A diaphragm 68 also interconnects with an actuator in receptacle 66 (not shown) for pressurizing ink supply reservoir 62. An electrical interconnect 70 makes connection with at least one contact land 72 on a circuit substrate 74. A serial memory chip 76 (Fig. 5) is positioned on circuit substrate 74 and is covered by an overcoat 78. Memory chip 76 enables input/output of data over a single access wire. Ink cartridge 60 includes keying features 80 which mate with additional keying features on receptacle 66 to assure that ink cartridge 60 can only be inserted if it is the correct ink color, has an ink that is compatible with the printer system and is positioned in the proper orientation. Receptacle 66 is fluidically connected to an ink jet pen 82 via a conduit 84. Both ink jet pen 82 and receptacle 66 are electrically connected to a microprocessor 86 which controls the operation of the ink jet printer.

[0040] As is known, the operation of ink jet pen 82 is controlled by microprocessor 86 in accordance with various parameters derived from a printer driver. Among those parameters are default drop firing frequencies (i.e., high quality mode, draft mode); a parameter which determines the pulse width of a signal applied to individual heater resistors; a parameter for controlling an amount of pre-warm current to the print head to enable optimum and stable printhead temperature during printing operations; a parameter designating the number of drops to be ejected per pixel; service station parameters; print mode data (i.e., parameters enabling the printer to achieve a specified print quality and print appearance; and an algorithm which enables the amount of ink used and remaining, to be determined.

[0041] The pulse width parameter determines the thermal inkjet resistor firing energy, as the applied voltage is usually kept constant. The parameter controlling prewarm current enables control of substrate temperature and thus drop volume. By modulating the prewarm current, drop volume variations which cause a variation in print quality can be avoided. Print mode parameters control the geometry of the dot array.

[0042] At least some of the above-noted parameters and procedures are, in addition to being present in the printer driver, stored on memory chip 76. At each commencement of a print job, microprocessor 86 interrogates the contents of memory chip 76 and alters the stored parameters of the printer driver in accordance with the accessed data. Thereafter, the ink jet printer is enabled to operate in accordance with those parameters in the known manner.

[0043] An important feature of this invention is that ink cartridge 60 is the most often replaced unit in an ink jet printer. Thus, if an alteration to parameters or modification of an algorithm, is required as a result of an engineering change to the printer, the revised parameters can be inserted into memory chip 76 upon manufacture of ink cartridge 60. When cartridge 60 is thereafter purchased by a user and inserted into the ink jet printer, all of the changed parameters are automatically made available to microprocessor 86 -- achieving an updating of the operation of the ink jet printer without requiring special efforts to distribute modified printer drivers. As a result, over a short period of time, all installed ink jet printers are updated to the most recent parameter and algorithm set, simply through the act of purchase of replacement ink jet cartridges 60.

[0044] Among the parameter data contained in memory chip 76 may be the following: actual count of ink drops emitted from the cartridge; date code of the ink supply; date code of initial insertion of the ink cartridge;

system coefficients; ink type/color; cartridge size; print mode; temperature data and heater resistor parameters; age of the cartridge; drop count for the print head; a pumping algorithm; printer serial number; cartridge usage information, etc.

[0045] Such data enables microprocessor 86 to perform a number of control functions within the ink jet printer. For instance, microprocessor 86 calculates an estimate of remaining ink in cartridge 60 and compares the estimate against pre-recorded supply thresholds. If the ink is found to be less than 25% of full capacity, a message is provided to the user indicating that fact. Further, when a substantial portion of the last 25% of ink is consumed, microprocessor 86 can disable the ink jet printer (and to further enable the user to override the disablement), while simultaneously recording the fact of the override in memory chip 76.

[0046] The data stored in memory chip 76 can further enable microprocessor 86 to determine that the proper ink type and color is installed; provide a warning to the user about a possible shelf life expiration and further provide the user with a warning against use of the ink. By coding the memory with an ink supply identifier, the printer can determine when the supply will run out of ink. Thus, the printer can begin attempting an out-of-ink determination at a strategic point of time - rather than running the procedure continuously.

With respect to out of ink detect, low ink warning, and printer feedback functions, before starting a print job, the printer will read the supply size (among other parameters) from the ink cartridge. It will compare the read parameters with an estimate of the amount of ink consumed. The first time a cartridge is used (for a particular color), the printer will have to assume a conservative (large) value for the drop volume. Later, when the printer/computer determines that the ink level is low, it will fire into a spittoon, detecting the thermal rise from a thermal sense resistor (TSR). The temperature will tend to spike up more when the ink supply is near empty. When the supply is actually empty, the printer uses that information to recalculate the drop volume. In this way, the printer "learns" and becomes more accurate at drop counting. A conservative way to use this information is to take an intermediate point between the value calculated and the initial conservative drop volume value. Over time, the value used for drop counting will approach the calculated value for all supplies used. In addition, as drop volumes become better controlled and understood, the initial conservative drop volume estimate programmed into the memory can be updated.

[0047] With respect to printer serial number and usage information, the printer is enabled to update the data which records the type of usage (average print density, etc.) A mail-in program of used cartridges allows the manufacturer to gather marketing information about how the printers are being used. From this information, parameters on the chip can be further optimized. One way to store usage information is for the printer to store information on average print density and amount of ink consumed for each page printed. Other metrics, such as percent graphics and test can be stored. The printer/driver then condenses the information and stores it as a series of numbers on the cartridge near the end of the supply life.

[0048] With respect to storage of the dot placement correction algorithm on the cartridge, as more information regarding ink jet pen production is obtained, a more accurate method for correcting of dot placement errors can be derived. For example, in the scan direction, variations in the nozzle trajectories cause the dots to vary in placement. Such variations are known as SAD (scan axis directionality) errors. Such variations can be compensated by changing the timing of nozzle firing - a parameter on the cartridge.

[0049] The ink pump which actuates the cartridge may fail due to fatigue. Thus, by recording the number of cycles seen by the pump on the cartridge memory, such failure can be anticipated. If the pump is used too much, then the pumping is reduced or stopped in order to prevent an ink spill. Thus, the maximum throughput (ml of ink per minute) can be reduced to accommodate the reduction or elimination of pumping. Additionally, since pump life may improve over with improved manufacturing techniques, an estimate of pump life recorded in the cartridge memory can be updated.

[0050] Since drop volume per impulse of a heater resistor is determined by an algorithm which is, in turn, dependent upon system parameters, the revised parameters enable optimal calculation of drop volume. Since the parameters can be continuously updated during the life of the printer, as new ink cartridge are installed, optimal print quality is achieved. Further, pulse widths, pulse warming energy, variations in the number of drops per pixel, etc. all may be altered and controlled in accordance with system improvements.

[0051] Turning to Fig. 6, the logic diagram shown therein illustrates the interaction of the ink jet printer with the data stored on memory chip 76. At power up or when a print job starts (decision box 100), the system parameters are read from ink cartridge memory chip 76 (box 102). Those parameters are then used to update the printer driver default parameters (box 104) and the printer then employs the default pulse width, pulse warming energy, firing frequency and multi-drop count to control print quality (box 106).

[0052] As printing progresses, microprocessor 86 employs the drop volume coefficients, drop count and temperature measurements to estimate ink usage. Periodically, the ink usage quantity in memory chip 76 is updated (box 108) and if the ink supply is found to be too low (decision box 110), a warning message is provided to the user or, in the alternative, the print job may be thereafter disabled -- subject to override (box 112). Upon completion of the print job (decision box 114), revised parameters are written back to memory chip 76 in readiness for the next operation of the ink jet printer (box

116).

[0053] Fig. 7 illustrates further details of the procedure employed by the printer with respect to ink usage parameters derived from the ink cartridge.

[0054] It should be understood that the foregoing description is only illustrative of the invention. Various alternatives and modifications can be devised by those skilled in the art without departing from the invention. Accordingly, the present invention is defined by the appended claims.

Claims

Claims for the following Contracting States : DE, FR, GB:

1. A replaceable ink cartridge (60) for an ink jet print head (82) of an ink jet printer, the ink jet printer being controlled by processor means (86) and including a receptacle (66) for receiving said ink cartridge (60), said receptacle (66) including first connector means (70) coupled to said processor means (86); said ink cartridge (60) comprising:

   an ink reservoir (62) for holding a supply of ink;
   second connector means (76) for mating with said first connector means (70) upon insertion of said ink cartridge (60) into said receptacle (66);
   fluid coupling means (64, 84) for connecting the ink reservoir (62) to said ink jet print head (82) upon insertion of said ink cartridge (60) into said receptacle (66); and
   a serial access memory (40) connected to said second connector means (76) and including only a single data input/output wire (42), said memory (40) thereby being made accessible to said processor means (86), said serial access memory (40) storing data at least indicative of usage of ink in said ink reservoir (62), the memory content being maintained when the replaceable ink cartridge is removed from the printer.

2. A replaceable ink cartridge ink cartridge (60) according to claim 1, wherein said serial access memory (40) includes parameter data for controlling said ink jet printer.

3. A replaceable ink cartridge (60) according to claim 2, wherein said parameter data, upon being accessed by said processor means (86), enables said processor means (86) to combine said parameter data with other data so as to enable the generation of control signals for said ink jet printer and ink jet printhead (82).

4. A replaceable ink cartridge (60) according to any preceding claim, wherein said serial access memory (40) stores a serial number indicative of said ink cartridge (60), said processor means (86) including stored data which enables identification of said ink cartridge (60) upon a reading of said serial number from said serial access memory (40) and a comparison thereof with said stored data.

5. A replaceable ink cartridge (60) according to any preceding claim, wherein said serial access memory (40) is coupled to said second connector means (76) by said single wire.

6. A replaceable ink cartridge (60) according to any preceding claim, in combination with said ink jet printer.

Claims for the following Contracting State : IT

1. A replaceable part (60) for an apparatus for making marks on media sheets, which apparatus is adapted to receive such a replaceable part that is subject to wear or includes a consumable that is employed during operation of said apparatus, said apparatus including processor means (86) for controlling said apparatus, a receptacle (66) for receiving a replaceable part (60) and first connector means (70) associated with said one receptacle (66) and coupled to said processor means (86), said replaceable part (60) comprising:

   a second connector means (76) that mates with said first connector means (70); and
   a serial access memory (40) that is connected to said second connector means (76) by a single data input/output wire (42), said serial access memory (42) storing data at least indicative of usage of said replaceable part (60), said processor means (86) being adapted to both read and write data from and to said serial access memory (40), the memory content being maintained when the replaceable part (60) is removed from the apparatus.

2. A replaceable part (60) according to claim 1, wherein said serial access memory (40) further stores calibration data for said apparatus, said processor means (86) being controlled to access said calibration data and to combine said calibration data with other data so as to enable the generation of control signals for said apparatus.

3. A replaceable part (60) according to claim 1 or claim 2, wherein said serial access memory (40) stores a serial number indicative of said replaceable part (60), thereby enabling said processor means (86)

including stored data to effect identification of said replaceable part (60) upon reading of said serial number from said serial access memory (40) and a comparison thereof with said stored data.

4. A replaceable (60) according to any preceding claim, wherein said serial access memory (40) is coupled to a fuser assembly and includes data regarding past usage history of an incorporated silicone oil supply, thereby enabling a said processor means (86) responding to said data regarding past usage history to modify a temperature of said fuser assembly upon determination that a transparency media sheet is to pass in contact therewith.

5. A replaceable part (60) according to any one of claims 1 to 3, wherein said serial access memory (40) is coupled to a developer module and stores a parameter defining a charge-to-mass ratio of toner carrier contained within said developer module, thereby enabling a said processor means (86) employing said parameter to modify a setting in said apparatus to compensate for said charge-to-mass ratio parameter.

6. A replaceable part (60) according to any one of claims 1 to 3, wherein said serial access memory (40) is coupled to a developer module and stores parameters defining a developer magnet strength and a distance between a surface of said developer module and a photoconducting drum, thereby enabling a said processor means (86) employing said parameters to enable adjustment of further parameters within said apparatus in response to the stored parameters.

7. A replaceable part (60) as claimed in any one of claims 1 to 3, wherein said apparatus is in the form of an ink jet printer which includes, as said replaceable part a consumable that is employed during operation of the apparatus in the form of a replaceable ink cartridge (60).

8. A replaceable part (60) as claimed in claim 7 for an ink jet print head (82) in an ink jet printer, wherein said processor means (86) is arranged for controlling said ink jet printer, said ink cartridge (60) comprising:

an ink reservoir (62) for holding a supply of ink; and wherein said second connector means (76) is arranged for mating with said first connector means (70) upon insertion of said ink cartridge (60) into said receptacle (66); and
fluid coupling means (64, 84) for connecting the ink reservoir (62) to said ink jet print head (82) upon insertion of said ink cartridge (60) into said receptacle (66);

said serial access memory (40) storing data at least indicative of usage of ink in said ink reservoir (62).

9. A replaceable part (60) according to claim 8, wherein said serial access memory (40) includes parameter data for controlling said ink jet printer.

10. A replaceable part (60) according to claim 9, wherein said parameter data, upon being accessed by said processor means (86), enables said processor means (86) to combine said revised parameter data with other data so as to enable the generation of control signals for said ink jet printer and ink jet printhead (82).

11. A replaceable part (60) according to any one of claims 8 to 10, in combination with said ink jet printer.

Patentansprüche

Patentansprüche für folgende Vertragsstaaten : DE, FR, GB

1. Eine austauschbare Tintenkassette (60) für einen Tintenstrahldruckkopf (82) eines Tintenstrahldruckers, wobei der Tintenstrahldrucker durch eine Prozessoreinrichtung (86) gesteuert wird und eine Aufnahmeeinrichtung (66) zum Aufnehmen der Tintenkassette (60) umfaßt, wobei die Aufnahmeeinrichtung (66) eine erste Verbindereinrichtung (70) umfaßt, die mit der Prozessoreinrichtung (86) gekoppelt ist, wobei die Tintenkassette (60) folgende Merkmale aufweist:

ein Tintenreservoir (62) zum Halten eines Tintenvorrats;

eine zweite Verbindereinrichtung (76) zum Zusammenpassen mit der ersten Verbindereinrichtung (70) auf eine Einfügung der Tintenkassette (60) in die Aufnahmeeinrichtung (66) hin;

eine Fluidkopplungseinrichtung (64, 84) zum Verbinden des Tintenreservoirs (62) mit dem Tintenstrahldruckkopf (82) auf eine Einfügung der Tintenkassette (60) in die Aufnahmeeinrichtung (66) hin; und

einen Speicher (40) mit seriellem Zugriff, der mit der zweiten Verbindereinrichtung (76) verbunden ist und nur einen einzelnen Dateneingangs/Ausgangs-Draht (42) umfaßt, wobei der Speicher (40) dadurch für die Prozessoreinrichtung (86) zugänglich gemacht wird, wobei

der Speicher (40) mit seriellem Zugriff Daten speichert, die zumindest den Verbrauch der Tinte in dem Tintenreservoir (62) anzeigen, und wobei der Speicherinhalt aufrechterhalten wird, wenn die austauschbare Tintenkassette aus dem Drukker entfernt wird.

2. Eine austauschbare Tintenkassette (60) gemäß Anspruch 1, bei der der Speicher (40) mit seriellem Zugriff Parameterdaten zum Steuern des Tintenstrahldruckers umfaßt.

3. Eine austauschbare Tintenkassette (60) gemäß Anspruch 2, bei der es die Parameterdaten daraufhin, daß auf sie durch die Prozessoreinrichtung (86) zugegriffen wird, ermöglichen, daß die Prozessoreinrichtung (86) die Parameterdaten mit anderen Daten kombiniert, um die Erzeugung von Steuerungssignalen für den Tintenstrahldrucker und den Tintenstrahldruckkopf (82) zu ermöglichen.

4. Eine austauschbare Tintenkassette (60) gemäß einem der vorhergehenden Ansprüche, bei der der Speicher (40) mit seriellem Zugriff eine Seriennummer speichert, die die Tintenkassette (60) anzeigt, wobei die Prozessoreinrichtung (86) gespeicherte Daten umfaßt, die eine Identifizierung der Tintenkassette (60) auf ein Lesen der Seriennummer von dem Speicher (40) mit seriellem Zugriff und einen Vergleich derselben mit den gespeicherten Daten hin ermöglicht.

5. Eine austauschbare Tintenkassette (60) gemäß einem der vorhergehenden Ansprüche, bei der der Speicher (40) mit seriellem Zugriff mit der zweiten Verbindereinrichtung (76) durch den einzelnen Draht gekoppelt ist.

6. Eine austauschbare Tintenkassette (60) gemäß einem der vorhergehenden Ansprüche in Kombination mit dem Tintenstrahldrucker.

Patentansprüche für folgenden Vertragsstaat : IT

1. Ein austauschbares Teil (60) für eine Vorrichtung zum Erzeugen von Markierungen auf Medienblättern, wobei die Vorrichtung angepaßt ist, um ein derartiges austauschbares Teil aufzunehmen, das einer Abnutzung ausgesetzt ist oder einen Verbrauchsartikel umfaßt, der während eines Betriebs der Vorrichtung verbraucht wird, wobei die Vorrichtung eine Prozessoreinrichtung (86) zum Steuern der Vorrichtung, eine Aufnahmeeinrichtung (66) zum Aufnehmen eines austauschbaren Teils (60) und eine erste Verbindereinrichtung (70) umfaßt, die der einen Aufnahmeeinrichtung (66) zugeordnet ist und mit der Prozessoreinrichtung (86) gekoppelt ist, wobei das austauschbare Teil (60) folgende Merkmale aufweist:

eine zweite Verbindereinrichtung (76), die mit der ersten Verbindereinrichtung (70) zusammenpaßt; und

einen Speicher (40) mit seriellem Zugriff, der mit der zweiten Verbindereinrichtung (76) durch einen einzelnen Dateneingangs/Ausgangs-Draht (42) verbunden ist,

wobei der Speicher (40) mit seriellem Zugriff Daten speichert, die zumindest den Verbrauch des austauschbaren Teils (60) anzeigen, wobei die Prozessoreinrichtung (86) angepaßt ist, um Daten sowohl von dem Speicher (40) mit seriellem Zugriff zu lesen als auch an denselben zu schreiben, wobei der Speicherinhalt aufrechterhalten wird, wenn das austauschbare Teil (60) aus der Vorrichtung entfernt wird.

2. Ein austauschbares Teil (60) gemäß Anspruch 1, bei dem der Speicher (40) mit seriellem Zugriff ferner Kalibrierungsdaten für die Vorrichtung speichert, wobei die Prozessoreinrichtung (86) gesteuert wird, um auf die Kalibrierungsdaten zuzugreifen und die Kalibrierungsdaten mit anderen Daten zu kombinieren, um die Erzeugung von Steuersignalen für die Vorrichtung zu ermöglichen.

3. Ein austauschbares Teil (60) gemäß Anspruch 1 oder 2, bei dem der Speicher (40) mit seriellem Zugriff eine Seriennummer speichert, die das austauschbare Teil (60) anzeigt, wodurch es ermöglicht wird, daß die Prozessoreinrichtung (86), die gespeicherte Daten umfaßt, eine Identifizierung des austauschbaren Teils (60) auf ein Lesen der Seriennummer von dem Speicher (40) mit seriellem Zugriff und einen Vergleich derselben mit den gespeicherten Daten hin bewirkt.

4. Ein austauschbares Teil (60) gemäß einem der vorhergehenden Ansprüche, bei dem der Speicher (40) mit seriellem Zugriff mit einer Fixierungsanordnung gekoppelt ist und Daten hinsichtlich einer früheren Verbrauchshistorie eines eingebauten Silikonölvorrats umfaßt, wodurch es ermöglicht wird, daß die Prozessoreinrichtung (86), die auf die Daten hinsichtlich der früheren Verbrauchshistorie anspricht, eine Temperatur der Fixierungsanordnung auf eine Bestimmung hin modifiziert, daß ein Transparenz-Medienblatt in Kontakt mit demselben durchlaufen soll.

5. Ein austauschbares Teil (60) gemäß einem der Ansprüche 1 bis 3, bei dem der Speicher (40) mit seriellem Zugriff mit einem Entwicklermodul gekoppelt

ist und einen Parameter speichert, der ein Verhältnis Ladung zu Masse des Tonerträgers definiert, der in dem Entwicklermodul enthalten ist, wodurch es ermöglicht wird, daß die Prozessoreinrichtung (86) unter Verwendung des Parameters eine Einstellung in der Vorrichtung modifiziert, um den Parameter des Verhältnisses Ladung zu Masse auszugleichen.

6. Ein austauschbares Teil (60) gemäß einem der Ansprüche 1 bis 3, bei dem der Speicher (40) mit seriellem Zugriff mit einem Entwicklermodul gekoppelt ist und Parameter speichert, die eine Entwicklermagnetstärke und einen Abstand zwischen einer Oberfläche des Entwicklermoduls und einer Photoleitertrommel definieren, wodurch es ermöglicht wird, daß die Prozessoreinrichtung (86) unter Verwendung der Parameter eine Einstellung weiterer Parameter in der Vorrichtung ansprechend auf die gespeicherten Parameter ermöglicht.

7. Ein austauschbares Teil (60) gemäß einem der Ansprüche 1 bis 3, bei dem die Vorrichtung in der Form eines Tintenstrahldruckers vorliegt, der als das austauschbare Teil einen Verbrauchsartikel, der während eines Betriebs der Vorrichtung verbraucht wird, in der Form einer austauschbaren Tintenkassette (60) umfaßt.

8. Ein austauschbares Teil (60) gemäß Anspruch 7 für einen Tintenstrahldruckkopf (82) in einem Tintenstrahldrucker, bei dem die Prozessoreinrichtung (86) zum Steuern des Tintenstrahldruckers angeordnet ist, wobei die Tintenkassette (60) folgende Merkmale aufweist:

ein Tintenreservoir (62) zum Halten eines Tintenvorrats,

und wobei die zweite Verbindereinrichtung (76) angeordent ist, um mit der ersten Verbindereinrichtung (70) auf eine Einfügung der Tintenkassette (60) in die Aufnahmeeinrichtung (66) hin zusammenzupassen; und

eine Fluidkopplungseinrichtung (64, 84) zum Verbinden des Tintenreservoirs (62) mit dem Tintenstrahldruckkopf (82) auf eine Einfügung der Tintenkassette (60) in die Aufnahmeeinrichtung (66) hin,

wobei der Speicher (40) mit seriellem Zugriff Daten speichert, die zumindest den Verbrauch von Tinte in dem Tintenreservoir (62) anzeigen.

9. Ein austauschbares Teil (60) gemäß Anspruch 8, bei dem der Speicher (40) mit seriellem Zugriff Parameterdaten zum Steuern des Tintenstrahldruckers umfaßt.

10. Ein austauschbares Teil (60) gemäß Anspruch 9, bei dem die Parameterdaten es daraufhin, daß auf dieselben durch die Prozessoreinrichtung (86) zugegriffen wird, ermöglichen, daß die Prozessoreinrichtung (86) die überprüften Parameterdaten mit anderen Daten kombiniert, um die Erzeugung von Steuersignalen für den Tintenstrahldrucker und den Tintenstrahldruckkopf (82) zu ermöglichen.

11. Ein austauschbares Teil (60) gemäß einem der Ansprüche 8 bis 10 in Kombination mit dem Tintenstrahldrucker.

Revendications

Revendications pour les Etats contractants suivants : DE, FR, GB

1. Cartouche d'encre de rechange (60) pour une tête d'impression à jet d'encre (82) d'une imprimante à jet d'encre, l'imprimante à jet d'encre étant commandée par des moyens de processeur (86) et comprenant un logement (66) pour recevoir ladite cartouche d'encre (60), ledit logement (66) comprenant des premiers moyens de connecteur (70) couplés auxdits moyens de processeur (86) ; ladite cartouche d'encre (60) comprenant :

un réservoir d'encre (62) pour maintenir une alimentation d'encre ;
des seconds moyens de connecteur (76) pour raccorder avec lesdits premiers moyens de connecteur (70) en insérant ladite cartouche d'encre (60) dans ledit logement (66) ;
des moyens de couplage de fluide (64, 84) pour relier le réservoir d'encre (62) à ladite tête d'impression à jet d'encre (82) en insérant ladite cartouche d'encre (60) dans ledit logemenL (66) ; et
une mémoire à accès séquentiel (40) reliée auxdits seconds moyens de connecteur (76) et ne comprenant qu'un câble unique d'entrée/sortie de données (42), ladite mémoire (40) étant de ce fait accessible auxdits moyens de processeur (86), ladite mémoire à accès séquentiel (40) mémorisant les données au moins indicatives d'usage de l'encre dans ledit réservoir d'encre (62), le contenu de la mémoire étant maintenu lorsque la cartouche d'encre de rechange est retirée de l'imprimante.

2. Cartouche d'encre de rechange (60) selon la revendication 1, dans laquelle ladite mémoire à accès séquentiel (40) comprend des données de paramètre

pour commander ladite imprimante à jet d'encre,

3. Cartouche d'encre de rechange (60) selon la revendication 2, dans laquelle les données de paramètre, sur accès par lesdits moyens de processeur (86) permet auxdits moyens de processeur (86) d'associer lesdites données de paramètre avec les autres données afin de permettre la génération de signaux de commande pour ladite imprimante à jet d'encre et la tête d'impression à jet d'encre (82).

4. Cartouche d'encre de rechange (60) selon l'une quelconque des revendications précédentes, dans laquelle ladite mémoire à accès séquentiel (40) mémorise un numéro de série indicatif de ladite cartouche d'encre (60), lesdits moyens de processeur (86) comprenant des données mémorisées qui permettent l'identification de ladite cartouche d'encre (60) sur lecture dudit numéro de série à partir de ladite mémoire à accès séquentiel (40), et une comparaison de celui-ci avec lesdites données mémorisées.

5. Cartouche d'encre de rechanqe (60) selon l'une quelconque des revendications précédentes, dans laquelle ladite mémoire à accès séquentiel (40) est couplée auxdits seconds moyens de connecteur (76) par ledit câble unique.

6. Cartouche d'encre de rechange (60) selon l'une quelconque des revendications précédentes, en combinaison avec ladite imprimante à jet d'encre.

Revendications pour l'Etat contractant suivant : IT

1. Pièce de rechange (60) pour un appareil pour faire des marques sur des feuilles de support, dont l'appareil est adapté pour recevoir une telle pièce de rechange qui est soumise à l'usure ou comprend un consommable qui est utilisé pendant le fonctionnement dudit appareil, ledit appareil comprenant des moyens de processeur (86) pour commander ledit appareil, un logement (66) pour recevoir une pièce de rechange (60) et des premiers moyens de connecteur (70) associés avec ledit un logement (66) et couplés auxdits moyens de processeur (86), ladite pièce de rechange (60) comprenant :

   des seconds moyens de connecteur (76) qui se raccordent avec lesdits premiers moyens de connecteur (70) ; et
   une mémoire à accès séquentiel (40) qui est reliée auxdits seconds moyens de connecteur (76) par un câble unique d'entrée/sortie de données (42), ladite mémoire à accès séquentiel (40) mémorisant les données au moins indicatives d'usage de ladite pièce de rechange (60), lesdits moyens de processeur (86) étant adaptés à la fois pour lire et écrire des données de et vers la mémoire à accès séquentiel (40), le contenu de la mémoire étant maintenu lorsque la pièce de rechange (60) est retirée de l'appareil.

2. Pièce de rechange (60) selon la revendication 1, dans laquelle la mémoire d'accès séquentiel (40) mémorise en outre les données de calibration dudit appareil, lesdits moyens de processeur (86) étant commandés pour accéder auxdites données de calibration et pour associer lesdites données de calibration avec les autres données afin de permettre la génération de signaux de commande pour ledit appareil.

3. Pièce de rechange (60) selon la revendication 1 ou la revendication 2, dans laquelle la mémoire à accès séquentiel (40) mémorise un numéro de série indicatif de ladite pièce de rechange (60), permettant ainsi auxdits moyens de processeur (86) comprenant des données mémorisées d'effectuer l'identification de ladite pièce de rechange (60) sur lecture dudit numéro de série à partir de la mémoire à accès séquentiel (40) et une comparaison de celui-ci avec les données mémorisées.

4. Pièce de rechange (60) selon l'une quelconque des revendications précédentes, dans laquelle ladite mémoire à accès séquentiel (40) est couplée à un ensemble de dispositif de fusion et comprend des données concernant un historique d'usage antérieur d'une alimentation d'huile de silicone incorporée, permettant de ce fait auxdits moyens de processeur (86) répondant auxdites données concernant l'historique d'usage antérieur de modifier une température dudit ensemble de dispositif de fusion en déterminant qu'une feuille de support par transparence doit passer en contact avec celui-ci.

5. Pièce de rechange (60) selon l'une quelconque des revendications 1 à 3, dans laquelle ladite mémoire d'accès séquentiel (40) est couplée à un module de révélateur et mémorise un paramètre définissant un rapport charge - masse d'un chariot de toner contenu à l'intérieur dudit module de révélateur, permettant de ce fait auxdits moyens de processeur (86) utilisant ledit paramètre de modifier un réglage dans ledit appareil pour remplacer ledit paramètre de rapport charge - masse.

6. Pièce de rechange (60) selon l'une quelconque des revendications 1 à 3, dans laquelle ladite mémoire d'accès séquentiel (40) est couplée à un module de révélateur et mémorise les paramètres définissant une résistance magnétique de révélateur et une distance entre une surface dudit module de révéla-

teur et un tambour photoconducteur, permettant de ce fait auxdits moyens de processeur (86) utilisant lesdits paramètres de permettre le réglage des paramètres supplémentaires à l'intérieur dudit appareil en réponse auxdits paramètres mémorisés.

7. Pièce de rechange (60) selon l'une quelconque des revendications 1 à 3, dans laquelle ledit appareil a la forme d'une imprimante à jet d'encre qui comprend, comme ladite pièce de rechange un consommable qui est utilisé pendant le fonctionnement de l'appareil sous la forme d'une cartouche d'encre de rechange (60).

8. Pièce de rechange (60) selon la revendication 7 pour une tête d'impression à jet d'encre (82) dans une imprimante à jet d'encre, dans laquelle lesdits moyens de processeur (86) sont disposés pour commander ladite imprimante à jet d'encre, ladite cartouche d'encre (60) comprenant :

un réservoir d'encre (62) pour maintenir une alimentation d'encre ;
et dans laquelle lesdits seconds moyens de connecteur (76) sont disposés pour se raccorder avec lesdits premiers moyens de connecteur (70) en insérant ladite cartouche d'encre (60) dans ledit logement (66) ; et
des moyens de couplage de fluide (64, 84) pour relier le réservoir d'encre (62) à ladite tête d'impression à jet d'encre (82) en insérant ladite cartouche d'encre (60) dans ledit logement (66) ;
ladite mémoire à accès séquentiel (40) mémorisant les données au moins indicatives d'usage de l'encre dans ledit réservoir d'encre (62).

9. Pièce de rechange (60) selon la revendication 8, dans laquelle ladite mémoire à accès séquentiel (40) comprend des données de paramètre pour commander ladite imprimante à jet d'encre.

10. Pièce de rechange (60) selon la revendication 9, dans laquelle lesdites données de paramètre, sur accès par lesdits moyens de processeur (86) permettent auxdits moyens de processeur (86) d'associer lesdites données de paramètre révisées avec les autres données afin de permettre la génération de signaux de commande pour ladite imprimante à jet d'encre et la tête d'impression à jet d'encre (82).

11. Pièce de rechange (60) selon l'une quelconque des revendications 8 à 10, en combinaison avec ladite imprimante à jet d'encre.

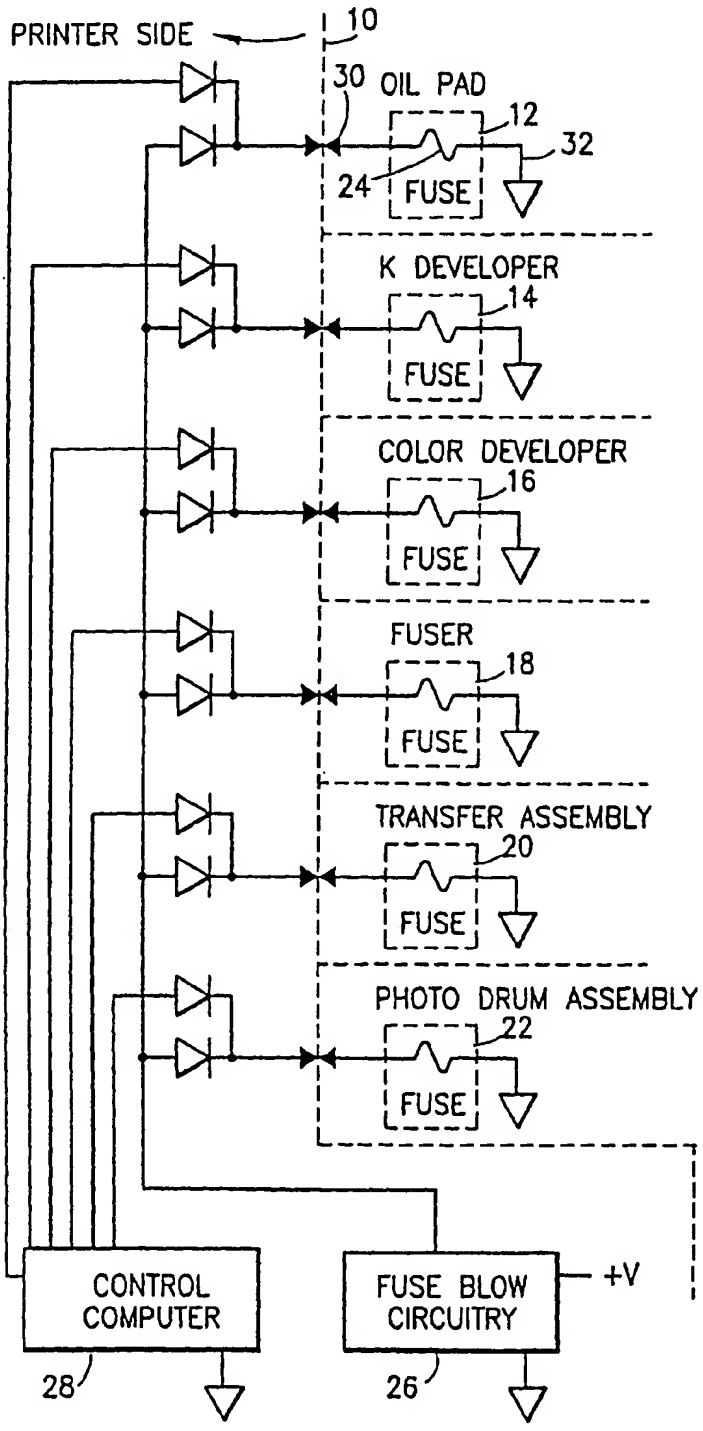


FIG. 1
PRIOR ART

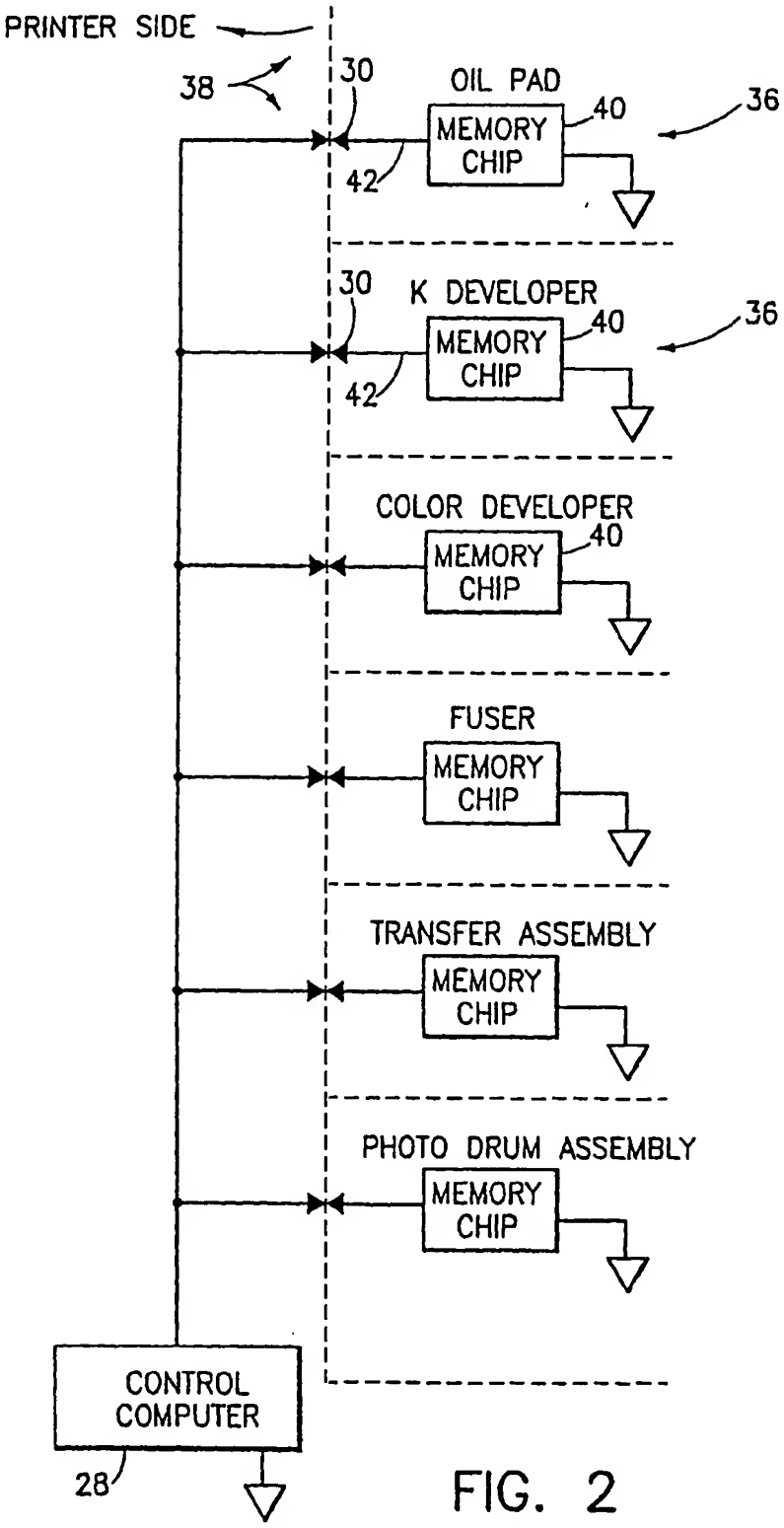

PRINTER SIDE
38
30
OIL PAD
MEMORY CHIP
40
36
42
30
K DEVELOPER
MEMORY CHIP
40
36
42
COLOR DEVELOPER
MEMORY CHIP
40
FUSER
MEMORY CHIP
TRANSFER ASSEMBLY
MEMORY CHIP
PHOTO DRUM ASSEMBLY
MEMORY CHIP
CONTROL COMPUTER
28

FIG. 2

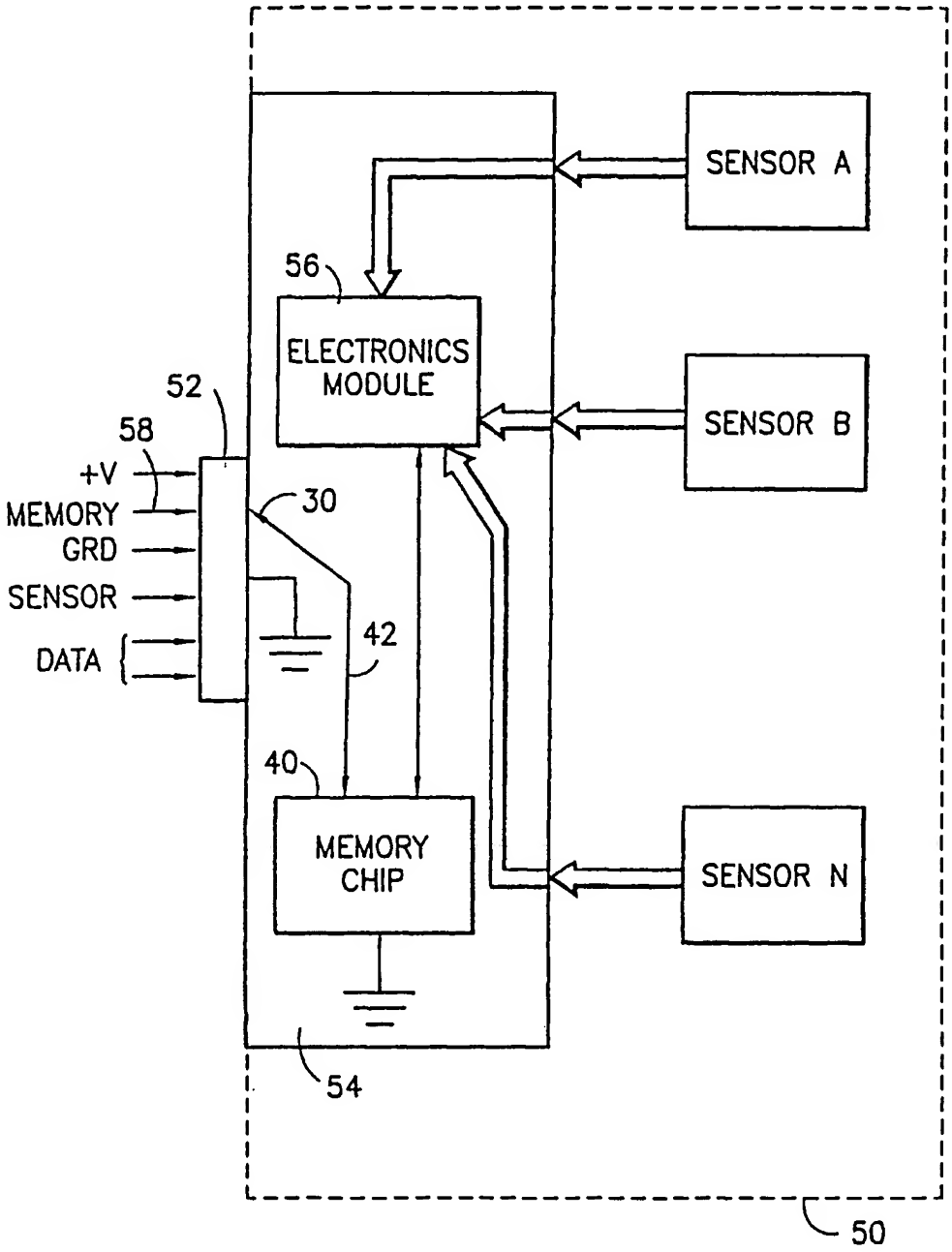

SENSOR A
56
ELECTRONICS MODULE
52
58
SENSOR B
+V
MEMORY
GRD
SENSOR
DATA
30
42
40
MEMORY CHIP
SENSOR N
54
50

FIG. 3

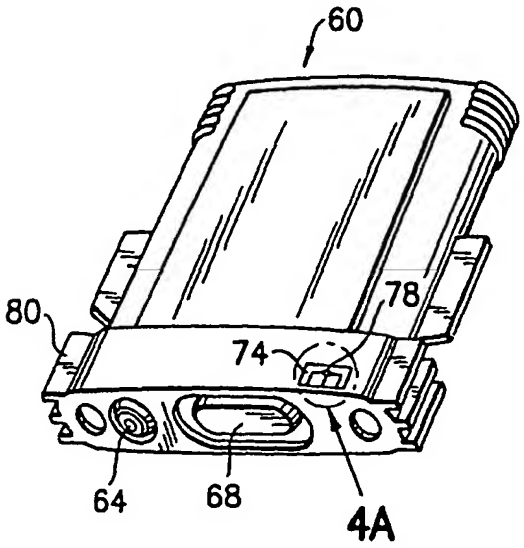


FIG. 4

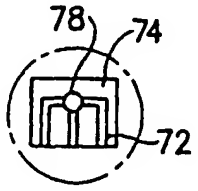


FIG. 4A

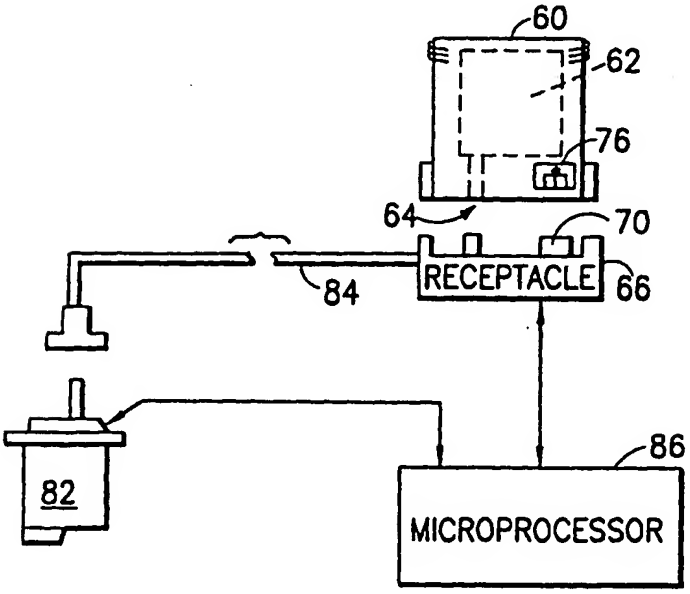
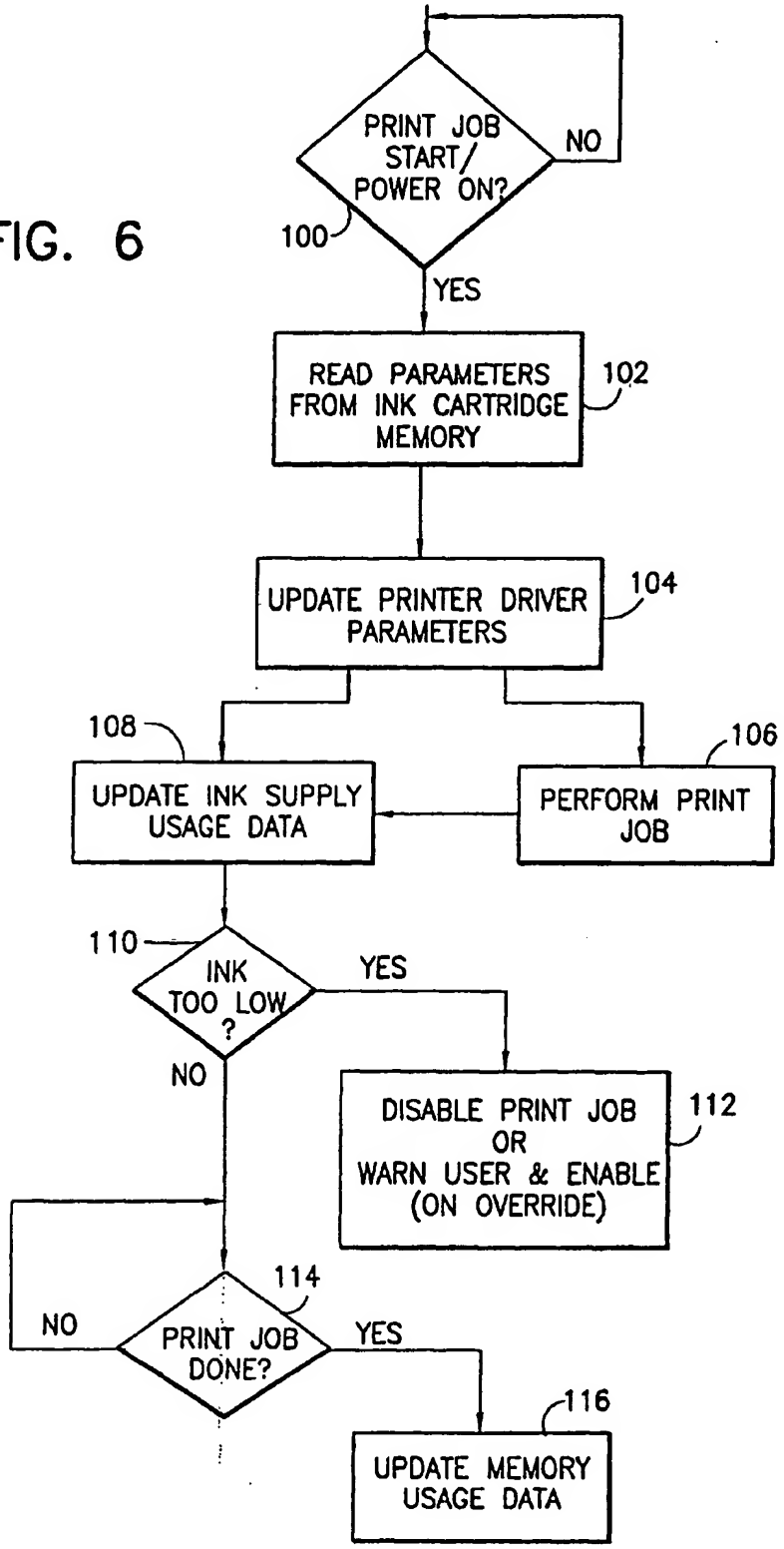


FIG. 5

FIG. 6


PRINT JOB START/ POWER ON?
NO
100
YES
READ PARAMETERS FROM INK CARTRIDGE MEMORY
102
UPDATE PRINTER DRIVER PARAMETERS
104
108
106
UPDATE INK SUPPLY USAGE DATA
PERFORM PRINT JOB
110
INK TOO LOW ?
YES
NO
DISABLE PRINT JOB OR WARN USER & ENABLE (ON OVERRIDE)
112
114
NO
PRINT JOB DONE?
YES
116
UPDATE MEMORY USAGE DATA

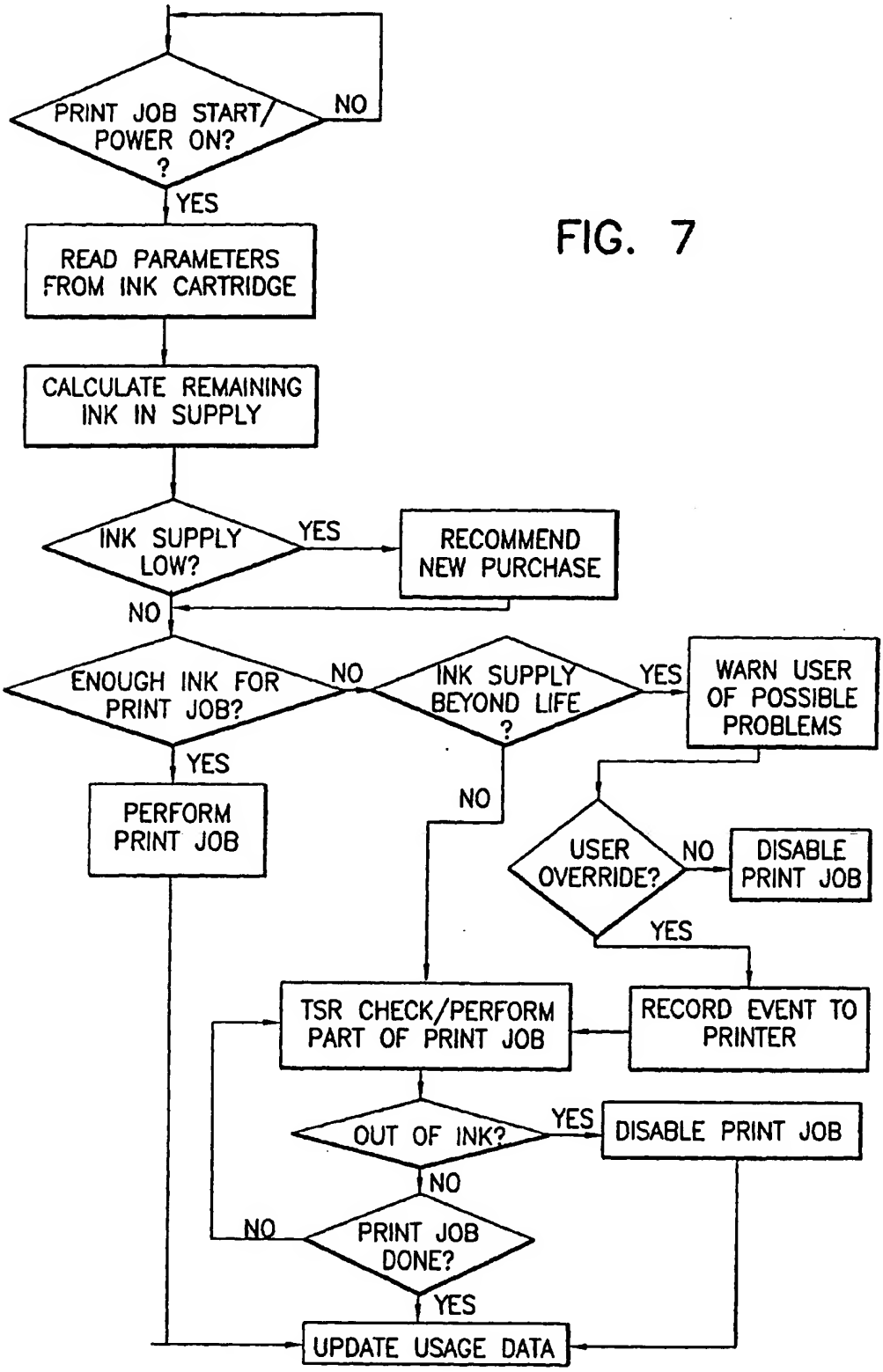

PRINT JOB START/ POWER ON?
NO
YES
READ PARAMETERS FROM INK CARTRIDGE
CALCULATE REMAINING INK IN SUPPLY
INK SUPPLY LOW?
YES
RECOMMEND NEW PURCHASE
NO
ENOUGH INK FOR PRINT JOB?
NO
INK SUPPLY BEYOND LIFE ?
YES
WARN USER OF POSSIBLE PROBLEMS
YES
PERFORM PRINT JOB
NO
USER OVERRIDE?
NO
DISABLE PRINT JOB
YES
TSR CHECK/PERFORM PART OF PRINT JOB
RECORD EVENT TO PRINTER
OUT OF INK?
YES
DISABLE PRINT JOB
NO
NO
PRINT JOB DONE?
YES
UPDATE USAGE DATA

FIG. 7